DOCUMENT RESUME

ED 324 446 CE 055 963

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TITLE Training for the Future. How Can Trainees Meet Current and Future Needs of Industry? Guidelines and Models for the Development of Interdisciplinary Assignments Based on the Concept of Key Technologies.
INSTITUTION Further Education Unit, London (England).; Training Agency, London (England).
REPORT NO ISBN-1-85338-199-3
PUB DATE 90
NOTE 68p.
PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Curriculum Design; Foreign Countries; Integrated Curriculum; *Interdisciplinary Approach; Models; Postsecondary Education; Technological Advancement; Technology Transfer; *Trade and Industrial Education
IDENTIFIERS *England

ABSTRACT

This document provides guidelines for the development of interdisciplinary assignments to help prepare learners for the developing needs of industry; it also contains a collection of model assignments produced by 12 British colleges. An introduction explains how to use the document and offers a checklist for the development of interdisciplinary assignments. Section 2 contains guidelines for the development of interdisciplinary assignments, assessing assignment development teams, evolving exercises, using the assignments, logistics, assessment, and staff development. The section concludes with brief descriptions of seven assignments produced by the college for this project. The bulk of the document is contained in section 3, which describes 23 model interdisciplinary assignments. Each assignment provides the name of the college that developed it, target group, estimated time, scenario, task, and method of assessment. Among the assignments are those on packaging perishable food; marketing gifts; organizing an exhibition on fire prevention; changing a garage door design; manufacturing a low-cost hand-held digital voltmeter; designing and manufacturing an artificial limb; investigating the energy balance in automobiles; analyzing the installation, commissioning, control, and costing of a gas turbine power generating plant; developing an understanding of the procedures and responsibilities associated with the supply of gas, water, or electricity to an industrial organization; establishing and operating a company to market a power supply for personal stereos; and monitoring the employment of individuals with disabilities. (CML)

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ISBN 1 85338 199 3

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TRAINING FOR THE FUTURE

How Can Trainees Meet Current and Future Needs of Industry?

Guidelines and Models for the Development of Interdisciplinary Assignments Based on the Concept of Key Technologies

by William Bolton and Albert Clyde

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Foreword

This document provides guidelines for the development of interdisciplinary assignments and contains a collection of model assignments produced by colleges participating in a Training Agency sponsored, FEU co-ordinated project. It is aimed at ensuring that education and training undertaken in the colleges provides learners with the knowledge, skills, abilities and attitudes to enable them to react to the developing needs of industry. The project sought to apply the principles established in *The Concept of Key Technologies* (FEU, 1989) as a basis for the development of general competences relevant to the future needs of technicians.

Twelve colleges established cross-departmental course teams and developed appropriate interdisciplinary assignments. Support for this was provided by a team of consultants from GlosCAT*, who visited the colleges periodically and offered advice with regard to the issues arising during the project. The assignments they developed are intended to be **models which can be adapted** to meet the needs and resources of individual colleges. However, to be effective, the assignments **must** be developed and run by interdisciplinary teams and **must** extend beyond traditional course boundaries. The aim is to mirror real industrial activity as far as possible.

Once again we are talking about a **new approach to technology**, emphasising the aspects of integration, application and added-value or economic aspects rather than the technology itself.

Our original publication in this field, *The Key Technologies: Some Implications for Education and Training* (FEU/Engineering Council, 1988) noted that there were two groups of students affected by the key technologies:

— those whose work is directly related to science and technology;

— those who will be affected by the wider application of the concept.

Therefore, while some of the project titles, and the courses for which they were initially designed, may seem out of place in a document aimed at training for the future needs of industry, we believe that it is necessary that a wider range of students should have experience of the application of technology, that industrially biased students should apply technology in situations which are not directly technological, and that students from different backgrounds should have the opportunity to work together on such interdisciplinary assignments.

BTEC was represented on the steering committees of both FEU projects relating to the key technologies. We are grateful to Tim Whitely for his assistance and advice on a number of occasions, and for providing the following BTEC comment on this document.

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* Gloucestershire College of Arts and Technology

'BTEC welcomes this report, which provides a valuable source of good ideas and practice for course teams involved in designing assignments for BTEC courses. It is refreshing to see the emphasis on integration through the programme of assignments and BTEC particularly welcomes the notion that assignments provide opportunities for assessment of both common (and other) skills and unit "subject matter". The need is to adopt an assessment profile to track the development of a student as he/she shows increasing ability in handling and applying theoretical concepts to realistic problems.'

In conclusion, interdisciplinary assignments offer a way to make learning more realistic, more closely related to a real industrial environment, more relevant to students and so, hopefully, they should enable students to cope better with the demands of the future. Furthermore, the outlay of a relatively small amount of money (£3000) to the colleges had an effect out of all proportion to the sum involved; it facilitated interdisciplinary team meetings and acted as a trigger, which has led to considerable development in the thinking of college staff and the production of model assignments.

FEU wishes to express thanks to the college staff for their enthusiastic work, the valuable input from the GlosCAT staff, and to Bill Bolton who co-ordinated reports from colleges and consultants.

FEU intends to monitor the ways in which the results of the project are assimilated into college curricula. Therefore you are invited to contact Albert Clyde at FEU, and describe your experiences, methods of application of the ideas raised and ways of adapting the model assignments.

Albert Clyde
Development Officer
FEU

1. Introduction

How to use this document

This document contains a collection of interdisciplinary assignments produced by colleges, together with guidelines and a check-list derived from the colleges' experience in their production. This project investigated the use of assignments based on the principles espoused in *The Concepts of Key Technologies* (FEU, 1989) as a basis for the development of general competences relevant to the future needs of technicians.

While the main aim is to provide materials to assist colleges to design assignments that are suitable for their students, it must be pointed out that it is not intended that these assignments are adopted and used as printed; rather, they should be adapted to fit the particular course and circumstances. They are primarily aimed at triggering ideas and initiating discussion **amongst interdisciplinary course teams** responsible for the development and management of the curriculum and the design of assignments. **The model assignments should be examined in conjunction with the specific aims of the particular course, the 'overarching' aims of the assignment and the check-list given in the text.** It should also be stressed that although the assignments have been developed in the context of a particular course and level, and aim to incorporate BTEC aims, they can readily be adapted to meet the requirements of other examining and validating bodies, and to different courses and levels.

The information given by the colleges for each assignment has been edited to a common format. There has generally been a reduction in length, with only outlines of the support material and assessment details being provided. The assignments are in no particular order.

WARNING! Project titles can often be misleading - they can only give the briefest description of content and, in any case, we believe that the various methods and approaches used can be adapted for other curricular areas.

'Overarching' aims of interdisciplinary assignments

The assignments aim to ensure that students develop the ability to:

- plan and innovate;
- extend their experiences beyond the bounds of their specific courses and disciplines;
- apply their own and other people's skills to the solution of problems;
- work as a team member;
- recognise the consequences of their solutions with regard to such factors as marketing, manufacturing, costs, company policies and effects on the environment.

Check-list for the development of interdisciplinary assignments

For college policy-makers

1. Have you considered the learning environment? Can it be made more relevant to students who are likely to face the uncertain demands of industry in the future?
2. Assignments offer a way to make learning more realistic, more closely related to a real industrial environment and more relevant to students. They thereby enable students to cope better with the demands of industry in the future. Is it college policy that all students should undertake assignments?
3. An effective interdisciplinary course team is essential for curriculum development and delivery and for the design of 'good' assignments. This requires the allocation of sufficient time and resources. Have you planned for this?
4. The logistics of assignment work need careful planning. Have you made such plans?
5. Have you considered the purpose of the assessment of assignments? To restrict the assessment of interdisciplinary assignments to the achievement of 'common' skills is to miss other important potential benefits.
6. A change to assignment-based learning is likely to require staff development: a change in student attitudes will have a change in staff attitudes as a prerequisite. Have you planned an appropriate staff development programme?

For validating/examining bodies

7. The structure of courses and nature of assessment criteria can be seen to place restrictions on the use of assignments to develop skills to meet future demands of industry. Are your policies and programme outlines sufficiently flexible and forward-looking to encourage innovation?

For college curriculum developers

8. Have you considered the wider ranging or 'overarching' aims for assignment work? They should prepare trainees to meet the demands of industry in the future (such aims imply more than 'design and make' or following instructions).
9. Do your assignments tackle a real problem rather than simply deal with elements of unit content? 'Paper exercises' or simple tasks grouped under a theme are not likely to be perceived as real problems.
10. Is the real problem to be used as the basis for an assignment capable of generating task material which would meet the 'overarching' aims?

11. In the real world, problems do not occur in isolation from other aspects of a company or its environment. Have you put the problems used for assignments into an appropriate context?

12. A vital issue is the extent to which an assignment can be open-ended (the more heavily structured or prescribed the task, the less likely it is to have 'overarching' aims). Do your assignments have open-ended objectives?

13. An information bank may need to be supplied. Have you made provision for one?

14. Have you made arrangements for each assignment to be checked against the 'overarching' aims of assignment work?

2. Guidelines for the development of interdisciplinary assignments

Introduction

It has been said that today's training prepares trainees to meet not future, or even current, needs but the needs of yesterday. By the time needs are articulated and curricula developed, the situation has changed and the curricula become, even when new, out of date. This is particularly true when technology is rapidly changing. Not only do the skills required of trainees change but their roles do too. So how can any curriculum be suitable for training trainees to meet the current needs of industry, never mind the future needs? The future is uncertain; the only reliable forecast that can be made is that there will be even more rapidly changing technology and more skill changes required of those in industry as a consequence.

Solutions that have been advanced to cope with this dilemma suggest that curricula should include a range of 'core' skills. Attempts have been made to define these in various documents; for example, *CPVE: Core Competences and Vocational Module Specifications*, Jan 1985.

Most of the cores as defined created difficulties, particularly for FE, since they were based to some degree on specific curricular content. Attempts to meet this problem were to be found in *Core Competences in Engineering: An FEU View* (FEU, 1985) and in *An Integrated Vocational Education and Training System for the Future* (FEU, 1988). The former suggested a curriculum based upon the elements **communication, planning, implementing and evaluating**. The latter describes a German project in which Volkswagen were seen to be particularly concerned with 'overarching' capabilities such as ability to think in terms of systems and to act in complex business situations by **solving problems** and **demonstrating flexibility and creativity, independence and responsibility**, and **the ability to communicate and co-operate**.

The National Curriculum has, in effect, created a 'core' for 5- to 16-year-olds which is mainly content based. In February 1989 Kenneth Baker, then Education Minister, raised the issue of a core for FE and recognised the problems associated with basing this on subject content.

FEU has suggested that a core curriculum for FE might incorporate three levels:

— fundamental core: based on process skills such as those outlined above;

— entitlement core: consisting of 'content' which is embedded in all aspects of the curriculum and is, therefore, inescapable. In practice this means that students can choose different subjects, e.g. health studies, certain foreign languages, etc. and yet in doing so always encounter the entitlement core;

— futuristic core: aimed at ensuring that trainees are able to adapt to technological demands that are unknown at present, or that are known about and are not yet a requirement although they may be in the future; for example, this might include a basic understanding of the processes of information technology.

In our view the development of such 'core skills' in students is synonymous with an understanding of the 'concept of key technologies', which involves interlinking and application of technological and economic issues through the development of realistic project and assignment work.

Historically, curricula have often been developed by considering what has been taught in the past and perhaps adding on some new subject material; a **subject-led approach**. This method would seem to have failed us. A different approach is to consider which of the various core skills and key technology concepts will now, and in the future, be required to meet the needs of industry; a **process-led approach**.

Notes for college managers

This project had three objectives - the production of:

- guidelines for interdisciplinary assignment development;
- models of interdisciplinary assignments for adaptation;
- a staff development exercise for those involved.

Most of the interdisciplinary assignments developed were based on BTEC schemes but are more widely applicable and, indeed, have already been applied in other circumstances.

Interdisciplinary assignments can be used in several ways:

- To enrich the learning experience by introducing a practical element where appropriate.
- To replace traditional teaching on a large scale so that the course team members become facilitators of learning and students experience realistic (if simulated) industrial conditions. The only limit is the motivation, time available and imagination of the staff.

Resource implications

Refer to *The Concept of Key Technologies* in detail.

In this project a small sum (£3000) was used to 'buy' staff time to enable the course team to develop appropriate assignments. In most cases teams of eight to ten were used, the exercise also being used for staff development purposes, occasionally incorporating a 'residential' as an induction process. The key element was the creation of a 'real' interdisciplinary course team. This was seen to be essential to the success of the process and applied across the whole range of team size (3-12).

The project

The Training Agency commissioned FEU to investigate a basis for the development of general competences relevant to the future needs of

technicians through interdisciplinary assignments involving key technologies. Twelve colleges were invited to participate, some funds being made available to 'purchase' staff time. Staff from these colleges attended seminars and were supported and monitored by consultants from GlosCAT. From this basis, these guidelines have been developed to help other colleges and training/education organisations to develop a curriculum framework to meet the current and future training needs of industry. This report is not a detailed evaluation of the project; rather it provides guidelines for colleges on how they can approach curriculum development, in accordance with the Training Agency brief above.

In this project assignments are considered as a basis for developing the skills required by students to enable them to cope with future demands of industry.

Assignment development teams

To develop the assignments, each of the twelve colleges in the project set up an inter-departmental team responsible to a head of department, dean or head of a faculty, or vice- or assistant principal. Half the colleges set up just a single team, the others two or three. These teams generally consisted of about six to eight members, each one being multidisciplinary but relating to the disciplines present on a particular course, although in some colleges the team members were drawn from a wider base.

Team membership from different departments and the consequent requirement for inter-departmental communication and co-operation was an invigorating feature for those colleges where this had not been the norm. Involving students from different courses and different departments was also invigorating, and more clearly mirrored industrial conditions.

In most cases team members were given reduced teaching loads, typically two hours a week for ten weeks (this being about the duration of the project). Three quarters of the colleges held a team meeting each week, the others having either one a fortnight or used a residential weekend workshop. Team meetings typically lasted from one to two hours.

The funds allocated to each college by FEU to 'purchase' staff time were limited (only £3000) but the evidence indicates that this small sum was an essential trigger in spurring college developments.

The development of assignments requires time and resources.

Why?

About three quarters of the teams directed their efforts to producing assignments for use in engineering, with the next major target being science. Only in a few instances were the assignments directed at students from more than one course or one department. For some teams the project was initially seen as being the development of some new assignments which could be termed integrative (in BTEC terms), or it involved some of the newer technology that was already included in the courses. However, other teams perceived the need to develop a new philosophy and

considered how they could set up situations whereby students could be part of a team tackling a real problem in its entirety.

The term assignments was generally perceived to mean prescribed tasks for groups of students, the duration being variable but often about eight to ten hours. The extent to which procedures and the task itself were prescribed varied between the colleges, with the task being given in detail and the procedures laid down in some cases, while in others it was only briefly outlined and the procedures had to be evolved. In some instances a task was suggested and then broken down into a group of related assignments, each being tackled by a different group of students. With feedback and interaction between the groups, this was found to be a useful way of tackling a large task. However, the grouping of a number of simple, straightforward tasks under a theme heading can mean missing many of the important features unless there is adequate co-ordination. Also there can be problems where an assignment is purely a 'paper exercise' and lacks elements of reality.

Some colleges initially had a narrow view of the term 'key technology', relating it to the new technology part of existing courses. Other colleges considered the philosophy underlying the key technology concepts and did not become 'hung up' on the term but rather saw it as indicating a need for students to innovate and think beyond the confines of their existing courses. Since courses were generally concerned with narrow segments rather than complete real problems, innovation was often developed in these new project-inspired circumstances. This would seem to be an essential first step in acquiring the skills to cope with key technology concepts.

Possibly due to the short timescale of the project, some teams rushed into developing assignments before considering their purposes fully. There was often an assumption that what was intended was the production of BTEC integrative assignments and this led to restricted aims for some assignments. The assignments which brought about a more successful application of the key technologies concepts required students to:

- plan and innovate;
- extend their research beyond the bounds of their courses and disciplines;
- apply their own and other people's skills to the solution of problems;
- work as a team member;
- recognise the consequences of their solutions with regard to such factors as marketing, manufacturing, costs, company policies and effects on the environment.

The overall aim was to put students into the type of situation they could face in the future. They would have to tackle, with others, a problem which could involve technology, not yet part of courses or even discovered, and evolve solutions, the consequences of which have got to be worked out. From this it emerged that the greater the degree of prescription imposed by staff, the less likely it is that these requirements, or the overall aims of the assignment process, will be met.

Colleges need to evolve a 'learning philosophy' directed at guiding students towards acquiring the skills required to meet the future demands of industry.

Evolving assignments

Some colleges evolved assignments by selecting a subject area, e.g. computer-integrated manufacturing, and then sought assignments within that subject area. This approach presented difficulties in that the assignments did not relate to the solution of a real problem, but rather to questions evolved to fit particular answers. Brainstorming sessions were used by some colleges to clarify suitable assignments. Whatever the approach, all too often assignments fitted a subject within a course rather than starting with a problem leading on to assignments which might or might not relate to such subjects. This re-emphasises the point that colleges need to evolve a philosophy directed towards students acquiring the skills needed to meet the future demands of industry. It is an indictment of existing courses that they are so oriented towards subject matter that college staff tend to think mainly in these terms rather than of the learning processes.

Assignments need to be seen as a means of tackling a real problem rather than dealing with elements of subject matter. 'Paper exercises' or simple tasks grouped under a theme are not likely to be perceived as the solution of real problems.

Using the assignments

In general the colleges used the assignments in BTEC courses as part of their programme of integrative assignments. About half were as part of an HNC or HND in some aspect of engineering. Others were mainly for use in BTEC National Diplomas (in catering, business studies, engineering, or science), with two colleges using them in National Certificate courses (in engineering). Two colleges related them to the BTEC First Diploma course (in science, and art and design).

The use of the model interdisciplinary assignments in BTEC courses was seen to place a constraint on the nature of the assignments and is probably one reason why they generally evolved from subjects (i.e. course elements) rather than real problems. The issue is obviously related to the perceived need for national validation/recognition.

It should be pointed out, however, that BTEC's view, as expressed by Tim Whitely, is rather different:

> 'BTEC would deny that the structure of its courses is a constraint on the nature and design of assignments and their assessment. The constraint lies often in the minds of deliverers who may think, not surprisingly, in terms of subjects not in terms of problems.'

The time students were allocated for the assignments was quite varied, typically from two to three hours per week for about three or four weeks, but sometimes up to two to three hours per week for a year.

The structure of existing courses is perceived to place a constraint on the extent to which assignments can be developed to enable students to gain the skills needed to meet future demands of industry.

Logistics

A major problem encountered by the colleges when using assignments was logistical. Accommodation, getting staff together for team meetings, 'custodial' staff, technicians, and health and safety were all features to be considered. Particular problems were posed when part-time staff were involved. While the logistics were seen to be easier when the assignments were closer to prescribed tasks, this defeats the purpose of introducing assignments. One possible approach to the problem is timetabling staff to rooms rather than courses; the students then visit the appropriate rooms for the help and facilities they require.

The logistics of assignment work need careful consideration.

Assessment

The assessment of students undertaking assignments was largely seen as consisting of the marking of individuals against a list of competences or general skill areas as a result of observation and/or questioning. Some use was also made of self-assessment by students.

The use of the assignments as BTEC integrative assignments led to some colleges only considering assessment in relation to the BTEC common skills. This meant that competences were generally grouped under such headings as: working with others, communicating, information seeking and analysis, identifying and tackling problems, numeracy, practical skills and design skills. Generally each competence was graded on a five-point scale and an overall grade arrived at by summation.

The following are two extracts from the assessment methods used by the Mid-Kent CHFE, the first being part of its overall integrative assignments skills statement and the second part of its self- assessment system:

1. Information-seeking and analysis
   - — Identify need for, and type of, information required.
   - — Identify and select appropriate sources.
   - — Review, classify, organise and evaluate information.
2. Problem-solving skills

	Doing well	Need to do more	Need to do less
Identifying problems of goals			
Giving ideas			
Evaluating ideas critically			
Summarising discussion			
Clarifying issues			

A grading system used in a few instances was related to the soundness of a proposal. Thus, for example, Crosskeys College gave:

— distinction for an appropriate method backed up by logical analysis without teacher guidance;

— merit for an appropriate method backed up by sound analysis with some teacher support;

— pass for a method with considerable teacher guidance;

— fail for no suitable method identified.

The question that needs to be posed is - what is the purpose of the assessment in each assignment? It can be more than a way of assessing the achievement of BTEC common skills alone.

The purpose of assessment needs to be identified. It should consist of more than an assessment of achievement of BTEC common skills.

Staff development

The learning involved in the processes occurring in carrying out assignments is the real purpose of the work, rather than the completion of a task or the production of some item. One of the important features for students is time management, so tightly restricting assignments by supplying information or prescribing the task can reduce the effectiveness of assignments. Students need to be forced to think. A consequence of this wider approach is that staff have to be open-minded and willing to move out of the confines of their 'traditional' role of information giver. A change in the attitudes of students has a change in staff attitudes as a prerequisite. Thus there is a vital need for staff development.

In the *Lecturer's Notes* accompanying Kingston CFE's Artificial Limb assignment (see later in this report for details), we find:

'Teaching by this approach is perhaps the most difficult and exacting of strategies. You need to be open to constant questioning by the students and discuss with them topics with which you may be unfamiliar. No longer will we be the all-knowing gurus the students may have perceived us to be.'

A change to assignment-based learning will require an appropriate programme of staff development.

Examples of assignments

The following are examples of some of the assignments produced by colleges during this project. These examples illustrate key areas where assignments may be developed.

1. Kingston College of Further Education: Artificial limb assignment

Kingston CFE evolved an artificial limb assignment for higher-level engineering students which required them to:

- research the technical and commercial aspects of artificial legs;
- design and carry out a full case-study of an artificial leg;
- draw up a technical and commercial specification;
- evaluate such a design both technically and commercially;
- manufacture a chosen key component of the design;
- place the role and control of 'quality' within this context.

The students were expected to use library facilities, contact relevant manufacturers and professional bodies and hold discussions with clinicians and patients. They should demonstrate appropriate elements of planning, implementation/production, evaluation and presentation.

A significant feature of this assignment is the emphasis on planning and reporting, both being vital characteristics of real projects in industry.

2. Mid-Kent College of Higher and Further Education: Gas turbine power generating plant

Another assignment involving a large element of planning was developed at Mid-Kent CHFE. It was based on a real problem being faced by a local company. The students were asked to:

- Analyse and report on the installation, commissioning, control and costing of a gas turbine power generating plant.

The assignment was broken down into four elements, the students being asked to:

- use the technique of project planning to show how the assignment can be controlled;
- plan and schedule the resources necessary for the installation, assembly and commissioning of the plant;
- determine which aspects of a gas turbine and its alternator are suitable for condition monitoring and develop a monitoring system;
- appraise the viability of the project.

Assignments linked to the real problems of industry can place aspects of course work in a wider context.

3. Matthew Boulton College: Design and evaluation of garage doors

In many of the assignments students were supplied with information packs. An example of this was the assignment for HNC students in Matthew Boulton College. It related to the manufacture of garage doors by Atlas Dorko Ltd., a company which felt that its turnover could be increased by offering a variation in fascia design in response to market demand, so changes in design and production methods needed to be considered. The students were to act as a team of consultants commissioned by Atlas Dorko to analyse the problem and prepare recommendations.

The assignment was broken down into a number of aspects:

- selection of the strip adhesive;
- design of the adhesive joint;
- design of the extruded aluminium frame section;
- quality control;
- assembly procedures;
- effect on operating costs;

- effect on the current work-force.

An information pack was supplied to the students.

The supply of comprehensive information packs can help students start their assignments and reduce the time required. This is particularly relevant for day-release students.

4. East Warwickshire College: Three-pin mains plug casing

National Certificate (block release) students at East Warwickshire College were required to:

- design the outer casing of a three-pin mains plug so that a person with limited use of hands and arms could insert and withdraw it easily and safely;
- estimate the costs of producing such a plug.

In carrying out the assignment the students were expected to:

- research the form and materials of existing plug casings on the market and the properties of the materials used for the casings;
- produce an appropriate design;
- select a manufacturing process for the casing;
- analyse the costs of production, considering in particular the additional costs of the design relative to conventional plugs;
- present a final written and oral report.

This assignment shows that a simple, cheap item can be made the basis for an assignment.

5. Swindon College/Crosskeys College: Packing for perishable foods

Swindon College and Crosskeys College both produced assignments on packaging for perishable/fast foods.

In the case of Swindon college the students were asked to:

- evaluate fast-food container production with special reference to the manufacture, dispensing and use of pre-portioned units;
- consider the packing materials that can be used following the phasing out of CFCs.

The students were required to:

- investigate current packing and packing materials;
- design packaging and the associated production process;
- evaluate the product.

In the case of Crosskeys College, students were asked to produce a detailed report giving advice on:

- the scientific reasons for the deterioration of perishable foodstuffs;
- the usefulness of plastic packaging material to the perishable food market;

- appropriate methods of packaging foodstuffs;
- methods of stock valuation for the perishable foodstuffs, together with advice on economic and efficient stocking levels.

A combination of these two assignments could result in a detailed consideration of a hypothetical company which plans to go into the packing industry, and provide a range of assignments spanning many disciplines within a college.

Assignments relating to food packaging may involve students from a variety of disciplines within a college.

6. Halesowen College: A company for power supplies

Most of the assignments developed by the colleges were for a specific group of students engaged on a particular course. A more wide-ranging approach was, however, adopted by Halesowen College, where students from a range of disciplines and courses were involved. The assignment was concerned with one product in a number of stages, including:

- market research
- forming a company
- running a company
- research and development
- marketing
- sales launch

This assignment could form the basis for the development of other assignments involving expansion of the company and the production of further items. The setting up of a hypothetical (?) company to produce some product is a source of realistic assignments covering a wide range of disciplines within a college.

This assignment demonstrates the development of a college-wide base for realistic assignments and acts as a focus for learning.

7. Bath College of FE/Richmond College/ Calderdale College: Computer-integrated manufacture

Some colleges developed assignments relating to computer-integrated manufacturing. For example, at Bath College of Further Education students were required to do the pilot study for the installation of a series of computerised inspection stations on the shop floor to provide a system of data capture and analysis covering a specific range of turned components.

Students at Richmond College were asked to investigate the feasibility of introducing a CAD system into a company. They had to act in an advisory role and produce a report suggesting an implementation strategy and justification for a CAD system.

A more ambitious assignment was that at Calderdale College. This involved the setting up of an integrated manufacture and marketing facility with the students being asked to design, cost, produce and 'sell' a product, with appropriate market research being carried out. They were also involved in the setting up of the facility.

Aspects of computer-integrated manufacture offer scope for a range of assignments in engineering and management courses.

3. Model interdisciplinary assignments

1. Packaging of perishable food

College:	Crosskeys College
Target group:	BTEC ND(2) in Business Studies,
Estimated time:	30 hours college time

Scenario

Wooltec Ltd. is part of a group of large out of town superstores specialising in the sale of mass-produced hardware items for the home and family. After a particularly bad year in the industry, they have decided it is time to diversify into another line of business and a meeting of the board of directors has led to a proposal that the company should expand into the perishable foodstuff market in order to satisfy consumer demand for a store where most products can be purchased without the necessity of moving from shop to shop.

Consequently they require specialist information about this type of business before 'taking the plunge' and have decided to engage a consultancy firm called SADT (Science, Art, Design and Technology) Ltd. to draft a report examining various aspects of the storing and sale of perishable foods.

SADT Ltd. are specialists in advising the food industry of the techniques employed in prolonging the shelf-life of perishable goods, especially on irradiation techniques, foodstuff deterioration and temperature maintenance. They also have considerable expertise in the design of food packaging and have won several awards for pack designs that reduce damage to food by staff and customer handling, while maintaining a creative and eye-catching appearance.

Task

Your brief as employees of SADT Ltd. is to produce a detailed report for the managing director of Wooltec Ltd., advising on:

1. the scientific reasons for the deterioration of perishable foodstuffs and the methods which may be used to increase the shelf-life of the product;
2. the importance of plastic packaging material to the perishable food market, explaining in detail the processes used in producing such packaging and the quality that can be expected;
3. appropriate methods of packaging foodstuffs, bearing in mind the financial constraints of the company and the likely effect on company sales, costs and revenue;

4. the best method of stock valuation for the perishable foodstuffs to be adopted by the inventory/management team, together with advice on economic and efficient stocking levels.

After studying your report the managing director of Wooltec decides to call a meeting of the board of directors where you are required to present your findings and recommendations in an appropriate professional manner, using a variety of communication techniques.

Assessment

A skills profile is used, the elements of the profile being:

- Technology - knowledge of, and the production of, packaging materials for the perishable food market
- Science - investigation of the scientific methods involved in the prolonging of the shelf-life of perishable foods
- Accounting - the identification and application of suitable stock control methods for the perishable food market
- People in organisations - the use of information technology to produce a written report and oral presentation incorporating appropriate audio-visual aids
- The organisation in its environment - awareness of the importance of packing as an element in the marketing mix and its implications as regards costs and revenue; awareness of the conflict between the best types of packing and financial constraints; and the application of the concept of price elasticity of demand
- Information technology - the production of a high-quality report using the latest software packages

Performance in each of these profile elements is graded overall as well as for self-development and self-management, learning and studying, working with others, communicating, information seeking, and problem solving. Specific requirements are given for each overall grade. For example, for accounting, where the aim is that students should be able to select an appropriate method of stock valuation for the product and explain the necessity of efficient and economic stock control methods in the perishable food market:

- Distinction - students have chosen an appropriate method of stock valuation backed up by logical analysis without teacher guidance. A sound appreciation of the need for efficient stock control is also required.
- Merit - students have chosen an appropriate method of stock valuation backed up by a sound analysis with some teacher support. An awareness of the reason for efficient economic stock control is also required.
- Pass - students have chosen, with considerable teacher guidance, a method of stock valuation for perishable food stuffs. Mention is made of the need for efficient economic stock control with brief reasons.

- Fail - students have not chosen a method of stock control and have not identified the importance of an efficient economic method of stock control.

NB. The assignment was carried out by Business Studies students working in groups of four or five over a three-week period. During week one, staff from all the departments concerned (Business Studies, Science, Technology and Languages) discussed with the students the work required. This was mainly in the form of seminars arranged in one-hour slots throughout the week. In week two students were allocated one and a half hours each day to monitor the deterioration of foodstuffs. At the end of the week all group members had a discussion with a biology lecturer about the scientific reasons for food deterioration and the methods which could be used to prolong the shelf life. In week three the students worked for the whole of the week on the assignment, including a visit to a supermarket for discussions with the store manager. At the end of the week they made an oral presentation.

2. It's a gift

College: Crosskeys College
Target Group: BTEC National Diploma in Business Studies and/or BTEC National Art and Design Diploma courses
Estimated time: 3 - 6 weeks continuous

Scenario

Having recently completed a BTEC National course, you decide that your career is to centre on managing your own business - marketing well-packaged gifts. You will need to secure funding for your enterprise. In formulating your business plan you should produce a sample of the product and packaging.

Task

You need to:

1. research, design and make a gift which could be promoted commercially;
2. research and design packaging and promotional material for the gift. This also incorporates some typographic design;
3. carry out market research, evaluation and modification procedures;
4. devise a business plan. This should include details of the progress of the assignment, information about funding agencies, market research, assured outlets, and costing of the proposed year- plan with regard to promotion, advertising, insurance and other hidden expenditure of the business. The opportunity costs of own qualifications, staffing, premises, equipment and other relevant factors are to be accounted for. You will be expected to do basic accounting in the profit forecast, showing gross profit and detailing collateral and borrowing requirements;
5. present final product and reference material to funding agencies and commercial outlets.

The above is seen as being achieved by the students carrying out the following tasks:

- Accounting - cost materials to establish price, produce cash budgets and break-even charts, design a bookkeeping system, produce and interpret forecast profit and loss accounts and balance sheets.
- People and organisations - contact agencies with regard to insurance, VAT, copyright, health and safety, PAYE, finance WDA; compile the business plan.
- Organisation in its environment - identify an appropriate product, compare alternatives, assess the position of the product in the market, determine a marketing strategy, decide on appropriate business information.

- Specialisation: ceramics, photography, textiles, print making, 3D studies, video - detailed researches into similar products, production of concept drawings and visualisation sheets, making the actual product.
- Design - detailed researches into similar packaging and promotional material, production of concept drawings and visualisation sheets, making of packaging, incorporation of type and other graphic material required by law, visualisation sheets for promotional material.

Assessment

A skills profile is used, the elements of the profile being:

- Information processing - using appropriate technology to present/sort data, calculation of information/input from data, storing and retrieving information, using information.
- Design and visual discrimination - making an appropriate choice of media, demonstrating manual dexterity, applying knowledge to designing/making an item, using appropriate forms of expression to isolate ideas and sensations.
- Group work - participating and working in groups and teams, identifying and responding to other people's ideas and feelings, identifying and responding to the needs of others, communicating personal ideas and feelings.
- Problem solving - selecting and using information for making decisions, setting goals and working out means of achieving them, recognising and applying social/technical/aesthetic values to decisions, recognising and comparing alternatives and modifying strategies and procedures.
- Communications - interpreting written/spoken/non-verbal information, recognising and responding to other people's ideas/feelings, finding information systematically, selecting, recording and retrieving information.
- Numeracy - identifying numerical aspects of decision-making process, using correct numerical procedures to produce information, interpreting numerical information, supporting conclusions using numerical data.
- Learning and studying - identifying one's attributes and abilities, identifying plans for personal needs and goals, managing and organising oneself, recognising and discarding irrelevant material.
- Information gathering - identifying situations and stages where decisions are needed, finding information systematically, selecting and recording information, making observations.

Grades (distinction, merit, pass or fail) are awarded in each of the above profile elements.

NB. A week-by-week schedule is negotiated with the students for the entire six weeks devoted to the assignment and they are required to report their progress to their tutor in accordance with this schedule.

3. A crèche

College:	Crosskeys College
Target group:	BTEC First Diploma in Caring
Estimated time:	24 hours college time

Scenario

A decision has been made to set up a staff/student creche facility in the college. A suitable area has been identified and set aside for conversion. You have to establish the need for the facility, plan the accommodation, order the equipment and organise the publicity and administration arrangements.

Task

1. What is a creche? The students have to read supplied background notes, visit a creche, consult relevant books, complete a questionnaire, give a short verbal report and participate in a general discussion.
2. Is there a need for a creche? What are the user requirements? Formulate a questionnaire, decide how the survey is to be carried out, carry it out and analyse the results.
3. Having established that a creche facility is required, the resources needed to establish it have to be determined. The room will be decorated and a water supply installed. A budget of £800 has been allocated to equip the creche. From the supplied catalogues choose suitable equipment and furniture, keeping within the budget, selecting furniture that will fit the room, and equipment that will meet relevant safety regulations.
4. Draw a plan of the creche, identifying the services available and ensuring a safe and efficient layout.
5. In order to operate the creche, a basic administration and finance system has to be devised. Identify and list the information required to maintain adequate records of all users, devise a record card, and set up a database to store the information on a computer. The creche has been set up with basic staffing. For a one-week period record total income and expenditure details. Analyse this and produce a financial summary.
6. Design and produce a small poster to promote the creche facility, considering not only the design and information to be presented, but also the production costs, numbers required and distribution.
7. To run the creche, additional money will be needed to add to income from clients. Suggest two possible fund-raising activities that could be organised by the people running the creche. Your suggestions should include a brief outline of how the event would be organised and approximately how much money each event would be expected to raise.
8. Consider electrical safety. List all the electrical equipment to be installed, together with its power rating, voltage and current. Note the

number of power points and the maximum safe current for each. Calculate the current taken by each piece of equipment, then select and fit the appropriate fuses after checking with the lecturer.

Assessment

For each of the tasks, students are given grades according to how well they are completed and the extent to which guidance has to be given. Thus, for example, for task 4, where four points have been identified:

- Distinction - satisfies all points unaided.
- Merit - satisfies all points with limited guidance.
- Pass - satisfies all points with considerable guidance.
- Fail - unsatisfactory layout produced despite guidance.

NB. Time proved to be a problem with this assignment. Successful implementation would have required a considerable amount of teaching/ learning input with students prior to commencement of the assignment.

4. Fire

College: Crosskeys College
Target group: BTEC First Diploma in Caring
Estimated time: 30 hours

Scenario

Although everybody is aware of the danger caused by fire in the home and would like to prevent fire occurring, there is a lack of general knowledge about fire prevention. As a class you are to organise an exhibition on fire prevention suitable for a stand at the college Open Day. You have been set a number of tasks which will let you gather information on the different causes of fire in the home and of the main danger areas. You will also collect information on some fire prevention devices and use it to help organise the exhibition. Remember, although this is an exercise in college, the danger from fire is **real**. An effective exhibition will give important information and may help to prevent the damage and injury that could result from a fire in the home.

Task

1. As a first step to mounting an exhibition on 'fire in the home' you need to find out where fires are most likely to occur. Take home the supplied line drawings of various parts of the home and mark all the places where you think a fire could start. Then compare your list with the copy of 'Fire Drill' from the *Which?* magazine (January 1989).

   In preparing for the exhibition you may wish to use some of the data from the *Which?* article and should write to obtain permission. The local Fire Brigade and the Royal Society for the Prevention of Accidents (ROSPA) may supply speakers to visit the college and discuss fire prevention and simple fire-fighting techniques.

2. House safety may be improved by installing fire/smoke detectors and other safety devices, and having simple fire extinguishers. You should investigate the range that is available.

   The class is divided into four groups to study the following areas:
   - kitchen
   - electrical goods
   - children
   - furniture and fittings

   Collect relevant information and prepare lists of suitable fire/smoke detectors, fire-prevention devices and fire extinguishers. Also devise effective methods of storing leaflets, photographs, diagrams, samples, written work, etc., which will allow easy access and safe storage for eventual use in the exhibition.

3. This task involves the students undertaking a series of experiments under supervision in a specialist working area. These could include the conditions required for combustion, appropriate methods of

extinguishing various types of fires and the prevention and detection of fire.

4. Having established the need for fire/smoke detection and alarm systems and investigated the various types available, you are now required to build and test a fire alarm. A circuit diagram is supplied.

5. Using the information you have collected in the previous tasks produce an exhibition in the main hall of the college on Open Day. Plan the exhibition taking the following points into consideration:

   - the best way to mount your work (including consideration of cost);
   - the lighting required and its source of supply;
   - if you are using electrical equipment, the convenience of power supply;
   - the size of information signs needed;
   - the staffing of the exhibition.

   It would also be desirable to consider the type of questions you are likely to be asked, and to prepare sample answers.

Assessment

Students are given grades for each of the tasks, the grade depending on the degree of achievement and the amount of assistance given. For example, for task 2:

- Distinction - actively participates in information gathering. Assists in setting up the storage system, shows understanding of the system and operates the system without help.
- Merit - collects relevant information and assists in the preparation of lists. Assists in the setting up of the storage system, shows understanding of the system but needs assistance in maintaining the system.
- Pass - reasonable participation in information gathering and list making. Involved in setting up and using the storage system, but needs considerable teacher guidance.
- Refer/Fail - fails to collect information. Does not use the storage system created.

NB. Pre-assignment work is considered essential. In this case it involved a visit to a fire station, a visit from a fire prevention officer, and a visit to a sheltered housing complex to look at fire safety.

5. Garage doors

College:	Matthew Boulton College
Target group:	Day-release BTEC HNC Mechanical Engineering
Estimated time:	Two weeks own time, one full day and evening, two weeks own time

Scenario

Atlas Dorko Ltd. employs 110 people and has been manufacturing up-and-over garage doors for the past 25 years. During the past five years its share of the market has remained static. Its product is of traditional construction, i.e. galvanised RSA frame with a galvanised steel fascia, pop-riveted into place. It is finished in grey or white primer.

The recent boom in house improvement and new house buying has seen a considerable increase in the demand for garage doors. Atlas Dorko management is concerned about its static market position (a decline in percentage terms due to the increase in market size) and wishes to improve the situation. It thinks that turnover could be increased by offering a variation in fascia design in response to market demand. In order to achieve this variation, changes in design and production methods need to be considered.

With an alternative design using an aluminium fascia and frame bonded with strip adhesives as a possible way forward, the company has commissioned a firm of consultants to analyse the problem and prepare recommendations. You are the team of consultants commissioned by Atlas Dorko.

Task

1. From the data sheet supplied, select a suitable strip adhesive for the purpose. Recommend the positioning of the adhesive and the amount required to support the fascia.

   NB. The existing riveted structure may be used as a guide to the required strength of joint. However, it is suggested that this is over-engineered as weaker fixings, capable of supporting twice the panel weight, would be adequate. Submit calculations to justify your recommendations.

2. Design an extruded aluminium frame section that will meet the following requirements:

   — allow frames of differing sizes to be quickly and easily assembled;

   — provide a sound joint between frame and fascia;

   — locate the fascia panel on assembly.

3. Specify the tests to be carried out on prototypes to guarantee the reliability of strip adhesives for this purpose. Also detail the in-process quality checks required for this purpose.

4. Recommend the assembly procedures that should be employed to ensure a sound joint and minimum assembly time.

5. The proposed design and manufacturing changes will have a considerable impact on operating costs. Using the attached financial statement as a basis and assuming that the changes took place during 1989, estimate the account for the year ending 31 December 1989.

6. Sixty people are currently employed in assembly work. The new process will reduce the need for assembly workers by ten per cent. It is envisaged that 50% of the number required for redundancy will be lost through natural wastage. Using the employee profiles provided, make recommendations for redundancy.

7. Conclude on the viability or otherwise of using strip adhesives for the assembly of garage doors.

8. Prepare a meeting agenda and present your recommendations to the board of Atlas Dorko Ltd.

The students were supplied with an information pack containing:

- manufacturing account for the year to 31 December 1988;
- fact sheet on employment law: redundancy;
- employee profiles;
- glossary of terms;
- aluminium and aluminium alloy extrusions, plate and sheet data- sheets;
- adhesive tapes data sheets;
- blind rivets data sheets;
- extract from *Engineering Design Guide 02: Adhesive Bonding*, by J.Shields (Oxford University Press);
- article on the use of adhesives with panels in car production, from Autocar and Motor , 30 November 1988;
- extract from catalogue giving details of sizes and ranges of garage doors.

Assessment

The assessment of the assignment is carried out at the time of presentation to the board (members of staff). Each member of the student group receives a common grade based upon the group's overall performance. The grid used as the basis of the assessment is as follows:

Common skills	(i)	(ii)	(iii)	(iv)	(v)	% of assessment
Researching literature	•	•				5
Analysis of tasks			•			10
Group work and involvement		•	•	•	•	10
Proposals for business and financial aspects			•	•		15
Development of technical proposals	•	•		•	•	30
Presentation	•			•		30

Common skills: (i) self-development, (ii) information seeking and analysis, (iii) identifying and tackling problems, (iv) communication: written and verbal, (v) working with others

6. Low-cost hand-held digital voltmeter

College: Matthew Boulton College
Target group: BTEC HNC in Electrical/ Electronic Engineering (Day-release mode)
Estimated time: Two weeks own time, a day and evening full- time, one week own time

Scenario

SSQ Instruments is a company presently manufacturing electrical instruments which are all analogue. There is a desire to increase market penetration by producing a range of digital instruments. As a first step, the manufacture of a low-cost, hand-held digital voltmeter, suitable for use on digital equipment, has been suggested by the newly appointed managing director (MD). The MD has asked the design and development team to investigate this possibility and present a report on its findings in time for the next board meeting in five weeks time. It is intended to commence production of the digital voltmeter within four weeks of the report being submitted.

Task

1. Investigate the current market and identify and select possible target groups for the sale of a low-cost, hand-held digital voltmeter. The findings should include a list of competitors producing similar voltmeters, and essential features of their meters, and important parameters, e.g. voltage range, accuracy, supply requirements, cost, special features, case material and appearance, overall dimensions, types of displays and numbers of digits and weight. Using the information gathered, propose a provisional specification.

2. The most expensive component in the design is likely to be an A/D converter. Investigate the common A/D chips currently available and select the most suitable for a two-and-a-half-digit display.

3. Develop a block diagram of the digital voltmeter which meets the provisional specification in task 1 and which includes the following essential features:

   (i) two-and-a-half-digit display;

   (ii) battery powered;

   (iii) logic level indicator (switchable between TTL/CMOS).

   Select all components for the design, showing any calculations of their values and also stating the criteria used in the selection.

   NB. It is recommended that the display should be limited so as to minimise design complexity and cost.

4. In a small group, discuss individual designs, specifications and component selection and agree on a design. Build a prototype circuit, test it for correct operation and calibrate it against a standard instrument. Measure its important parameters, such as accuracy and input impedance.

5. Find out what 'probe-type' cases are currently available on the commercial market and select the most suitable. State the modifications necessary to allow provision for mounting the LCD display, on/off switch, probe tip, LED Logic '0' and '1' indication, threshold level selector (TTL/CMOS) switch and earth lead. In designing the case consider the need for it to be comfortably held in the hand, to have a clear display, accessible switches, a case which has a pleasant appearance and, to limit production costs, the minimum modifications. It is expected that the CAD facility will be used for the modification and to provide the final drawing of the design.

6. Carry out a costing exercise to decide the production costs, the numbers to be sold to break even and the projected net yearly profit/loss. In the first year of production the maximum output is expected to be 10,000 units. A selling price of £30 has been suggested and the company wishes to make a profit of at least £40,000 in the year. A note giving details of terms and break-even analysis procedures is supplied.

7. Design a leaflet to be included in the sales literature, which is appropriate to the target group selected in task 1. This leaflet should include a concise description of the capabilities of the product and relevant technical data.

8. Finally, review the whole design and suggest possible improvements to make the product more competitive. In addition, carry out a brief feasibility study into the use of a custom-designed integrated-circuit chip for future mass production of the voltmeter.

The students were also asked to produce a final report which would be suitable for presentation to the Board.

Assessment

The performance in each task was marked against the appropriate common skills, weighting being used to obtain an overall grade. In addition, some marks were also awarded against BTEC unit objectives.

7. Artificial limb

College:	Kingston College of Further Education
Target group:	BTEC HNC Engineering and Business Studies
Estimated time:	One year

Task

The students are asked to:

1. design and carry out a full case-study of an artificial leg;
2. draw up a technical and commercial specification;
3. evaluate such a design both technically and commercially;
4. manufacture a chosen key component of the design;
5. examine methods for achieving good 'quality' and quality control for the product.

The students are expected to use library facilities, make both verbal and written contact with relevant manufacturers and professional bodies, and arrange and hold discussions with clinicians and patients. In tackling the assignment they are expected to plan, implement, evaluate and present. In doing this they should:

- produce a realistic plan for the project, e.g. research, undertake a feasibility/market survey, design, manufacture, test, produce technical literature, consider presentation, and make interim and final reports, with detailed plans for each aspect;
- designate areas of responsibility within the team and plan for, and hold, regular progress meetings;
- plan for, and produce, interim reports;
- produce a full design of a prosthetic lower limb for a mid-thigh amputee in the light of a market survey;
- produce cost estimates and set their own realistic budget and work within it;
- manufacture the chosen key component, producing appropriate advertising and technical literature;
- carry out an evaluation on any mathematical models produced and, as a result of developing and implementing relevant tests, on manufactured items;
- check the entire project against specification;
- prepare and present interim written reports, a final report and an oral report on marketing, with each group member being required to answer questions.

Assessment

A wide range of assessment methods are employed, consisting of tick lists for common skills, oral presentation, individual viva and written report. The common skill-assessment areas are formulating objectives, communicating with others (tactfully and sensitively), listening to and interpreting information, information gathering and evaluation, negotiating with others, working within a team and taking on different roles, identifying problems and defining tasks, decision making, planning techniques, problem solving, time management, organisation and record keeping, communication, and practical skills.

NB. Lecturer's notes and students' notes are supplied. The lecturer's notes include:

- a discussion of the assignment as a student-orientated learning environment and the problems that can arise from such an approach;
- project details and their relation to core and related topics;
- a note on the business studies input.

8. The motor car: energy and pollution

College: Kingston College of Further Education
Target group: BTEC National in Engineering
Estimated time: Varies

Scenario

There is much discussion of energy conservation and pollution at the present time. A significant part of the energy used in this country is that supplied as fuel to motor cars. In general, transportation uses about half the world's oil each year, but only about 20% of the energy supplied by the fuel results in motion, and the exhaust gases are a major source of pollution. Investigate the energy balance, i.e. what happens to the energy for a given amount of fuel, and the pollution and its control for motor cars. Consider the implications of the control of pollution for the efficiency of energy usage.

Task

Requirements

1. Determine and set a list of objectives for the assignment.
2. Working in small groups, make use of library facilities to research the principle of energy conservation and energy balance.
3. Explain in some detail the conversion of a given amount of fuel in the motor car into movement of the car, explaining where and how energy is 'lost'.
4. Describe in detail, in terms of the motor car, the pollution that can occur and discuss, in general terms, the current and possible future methods of reducing the problem. In particular, discuss lead-free petrol and catalytic converters and their effect on efficiency.
5. Investigate experimentally one aspect of energy conservation.

Planning

6. Produce an attainable plan for the assignment as a whole, with detailed plans for the various component phases.
7. Display these plans graphically.
8. List who in the group is going to be responsible for each area of the assignment.
9. Plan for, and hold, regular progress meetings.

Implementation/production

10. Produce drawings, circuit diagrams, schematics, etc. for the experiment.
11. For any components which need to be manufactured, produce full engineering drawings (CAD facilities are available).

12. Bearing in mind the accuracy required, select suitable instrumentation for the experiment.

Evaluation

13. Evaluate the experiment.
14. Have all the objectives been met?

Presentation

15. Demonstrate the experiment to lecturers and colleagues.
16. Prepare and present a written report.
17. Be prepared to answer, on an individual basis, points raised during an oral evaluation session.

Assessment

Grades are given for common skills and technical skills areas.

The common skills areas are:

- formulating objectives;
- gathering and evaluating information;
- working to a plan;
- identification of problems;
- definitions of tasks;
- problem solving and organisation and record keeping.

The technical skills areas are:

- experimental design;
- measurement;
- drafting;
- explanation and understanding of relevant terms and experimental technique.

9. Gas turbine power generating plant

College:	Mid-Kent College of Higher and Further Education
Target group:	BTEC HNC in Engineering
Estimated time:	120 hours

Task

The object of the assignment is to analyse and report on the installation, commissioning, control and costing of a gas turbine power generating plant.

Project management - assignment

1. Using the technique of project planning show how:
   - — the assignment will be controlled from launch to final presentation;
   - — tasks will be allocated to groups or individuals against an agreed time base for the whole assignment.

Project management - industrial

2. Using the technique of project planning, plan and schedule the resources necessary for the installation, assembly and commissioning of a gas turbine power generating plant.

Technological aspects

3. Determine which aspects of a gas turbine and its alternator are suitable for condition monitoring.
4. Using modern sensors connected to programmable logic controllers (or computers), develop a monitoring system for a gas turbine and its alternator. Demonstrate how the system operates either by the use of practical rigs or by computer simulation.

Costing

5. On the basis of information given on operating details and costs, recommend whether the company should proceed with this scheme now or wait until interest rates fall. Appraise the viability of the project using the 'net present value' method of assessing the return on capital outlay and applying it to the facts as given. The appraisal should be in the form of a brief report with supporting calculations and laid out in such a way that it can be quickly and easily understood by colleagues.
6. Work out the level annual instalment comprised partly of interest, partly of capital, that is necessary to repay the loan over a ten- year period. Having done this, construct a schedule showing how much of each annual instalment is comprised of interest and how much is capital.

Assessment

Both the product and the process are assessed, but the grading criteria are more concerned with progress, development and achievement as a result of the assignment than with the standard of performance displayed at any particular stage. Some assessment is formative and not the subject of grading. The assessment methods used are:

- lecturer observation - group activities and team tasks
- task group working papers - briefings, minutes, records
- self-assessment statements - discussed and negotiated with the tutor
- peer-assessment statements
- assignment products - reports, drawings, designs
- individual/group presentation

A proforma was used by the course team to show the level of achievement in each of the major common skills areas, the grading being on a one to five scale. The overall grades for common skills were based on progress and achievement rather than averaging of the points allocated to each skill area.

The following proforma was used for the common skills areas. It does not detail the range of common skills in each area, these being listed separately.

Common skills areas	Assignment element				Presentation
Personal development	1	2	3	4	
Self-management and organisation					
Working with others					
Written communication					
Oral communication					
Information seeking and analysis					
Using IT					
Problem solving					
Numeracy					
Practical skills					
Technology skills					
Design skills					
Summation					

NB. 1 = fail, 2 = refer, 3 = pass, 4 = merit, 5 = distinction.

The proforma used for the group oral assessment by the tutor required the tutor to give comments and a mark for organisation, content, presentation and evidence of original work. The following proforma was used for group self-assessment.

	Doing well	Needs to do more	Needs to do less
Communication skills			
1. Amount of talking I do in group			
2. Being brief and concise			
3. Being forceful			
4. Listening alertly			
5. Thinking before I talk			
6. Keeping my remarks on the topic			
7.			
8.			
Problem-solving skills			
1. Identifying problems or goals			
2. Asking for ideas, opinions			
3. Giving ideas			
4. Evaluating ideas critically			
5. Summarising discussion			
6. Clarifying issues			
7.			
8.			
Social relationships			
1. Competing to outdo others			
2. Being dominant towards others			
3. Trusting others			
4. Being helpful			
5. Calling attention to oneself			
6.			
7.			
General			
1. Asking questions of others			
2. Constructively criticising			
3. Accepting criticism			
4. Working towards harmony			
5.			
6.			

10. Power utilities in industry

College: Mid-Kent College of Higher and Further Education
Target group: BTEC HNC/HND in Engineering
Estimated time: Varies

Scenario

The economic well-being of a company can be very much affected by the supply of electricity, water and gas. Dependable, economic supplies are required.

Task

The aim is to develop an understanding of the procedures and responsibilities associated with the supply of gas, water or electricity to an industrial organisation. The assignment consists of three elements.

1. Information gathering

   For the supply industry chosen, extract and relate data relevant to supply to an industrial organisation, e.g. national arrangements for distribution, legal requirements and codes of practice.

2. Preparation of hand-outs

   Each group will produce a hand-out relating to their chosen industry. This document is to be made available to all other groups.

3. Presentation

   Each group will make a 15-minute presentation to other members of the class, independent observers and course tutors.

Assessment

As for the previous assignment.

11. A company for a power supply

College: Halesowen College
Target group: Full-time students from BTEC National courses in Business Studies, Engineering, Science and Health Studies: a college-wide project.
Estimated time: Varies

The project entails setting up a company, initially to market a power supply for personal stereos. In future years it is envisaged that the company will diversify into other products. The students will act as a team of consultants for the establishment and operation of the company.

Stage 1. Market research

Scenario

A team of field specialists from different work areas has been brought together to carry out market research on an idea for a low-cost mains-operated power supply for a personal stereo. If the results of the market research are favourable, a company will be set up to design, manufacture and market the appliance.

Task

Small-team tasks

1. Devise a maximum of 12 multiple-choice questions for a questionnaire. They must enable both technical and market data to be gathered so that information from the questionnaire can be used to help make decisions on the feasibility of the idea and product design. In the first instance, the market research is to be limited to the college population.
2. Design and produce, using IT, 12 copies of a sample questionnaire.
3. Prepare an oral presentation to explain the questionnaire, what information is expected from it and why that information is necessary.
4. Meet the other small teams and, using one or more team members, make an oral presentation to the whole group.
5. Evaluate the questionnaires produced by each of the other teams in the group.

Large-group tasks

6. Decide on how the large group's meeting is to be organised.
7. Choose the best combination of questions from all those submitted by the small teams.
8. Choose the best design of questionnaire submitted. In reaching a decision, bear in mind the quantity to be produced, the quality required, the technology available and the likely cost.

9. Decide on the quantity required and who is to manufacture them.
10. Decide how the market research is to be carried out, who is to carry it out, and when it is to be carried out.
11. Obtain staff approval for 9 and 10.
12. Produce the questionnaire and carry out the market research.

Small-team tasks

13. From the completed questionnaires extract the following information:
    - maximum price possible for appliance;
    - with a view to creating projected sales data, numbers willing to purchase the appliance;
    - indications as to power supply, technical specifications;
    - how often the device would be used and the place of use;
    - the number of people who own or use a personal stereo.
14. Using information technology, create a database and install data with the aim of producing a computerised report.
15. Produce a written report with recommendations to support the accompanying results.

Stage 2. Company formation

Scenario

Following the encouraging results obtained from the market research, it has been decided to produce and sell the mains-operated dc power supplies. In order to start this enterprise it will be necessary to form a private limited company.

Task

1. Create a name for the company.
2. Hold a meeting, nominate a chairperson, discuss and decide the company's aims and objectives.
3. Working in small groups, complete the following tasks:
    - Write the content to be included in the memorandum of association, giving consideration to the proposed activities of the company. Draft a suitable 'objects' clause to be included in the document.
    - Write the articles of association, giving particular attention to the voting rights of members and the powers and duties of the directors. Decide upon capital structure and the number of shares to be issued.
    - Research possible sources of finance for the venture. Investigate methods of raising the necessary funding either from college sources, fund-raising activities or external schemes/grants. Prepare a report on the findings to be presented at a forthcoming board meeting.

- Decide upon the structure of the company. Recommend the appropriate formation for the board of directors, identifying the areas of responsibility for each director. Construct an organisation chart, identifying management, key personnel and workforce. Using appropriate materials, prepare the chart for presentation to the whole group.
- Design and produce examples of the company logo/letterheading.

4. Arrange and hold a meeting of the whole group. Each of the five groups present their findings. Elect a board of directors and key personnel. The elected secretary will obtain and complete the necessary documents for company registration.

Stage 3. Running the company

Task

Having established and registered the company, it is now necessary to complete the following tasks:

1. Obtain the costs of research and development of the product.
2. Obtain the necessary information to construct a cash-flow forecast and projected final accounts for the first six months of trading. Relevant information will include:
   - initial cost of R and D;
   - projected sales revenue for the first six months;
   - projected direct and indirect costs, including raw materials, labour, power and heat, storage costs, salaries, loan and interest payments;
   - liaison with the production department to ensure that all necessary costs have been included in the cash budget.
3. Using the cash-flow forecast, construct a simple set of final accounts which will project profit/loss for the first six months of trading.
4. Using word-processing software, produce a report incorporating the above information in a suitable form for presentation at a board meeting.
5. Construct a simple stock control system, using database software (dBase III).
6. Using accounting software, set up a simple bookkeeping system to record the day-to-day transactions of the company. The system should include sales ledger, purchase ledger, nominal ledger and cash book.
7. Having projected trading figures for the first six months, make an appointment at a local bank, present the information to the bank manager, discuss the proposal and request funding for the project. Open a bank account in preparation for trading to commence.
8. Produce an induction booklet for distribution to all employees of the company. Use appropriate logos, artwork and illustrations. Suggested items for inclusion are:

- medical and welfare;
- canteen facilities;
- staff appointments;
- pay negotiations;
- worker incentive schemes;
- health and safety requirements;
- social facilities;
- pension scheme;
- security measures;
- fringe benefits.

This list is not definitive and you may decide to include other items as appropriate.

9. Having read the above tasks, hold a meeting of the group. Discuss the requirements of the assignments and allot tasks to be completed by appropriate key personnel and groups. Clarify the objectives of each task and set a date for completion. Arrange a further meeting at which each group will present their completed task in suitable form.

Stage 4. Research and development of a prototype power supply

Scenario

The object of this assignment is to design, build and test a prototype boxed dc power supply suitable for a personal stereo. The complete module should be of reasonably small size and of low cost. Keep a record of how the assignment is carried out and produce a file upon completion. To facilitate costing for the final product, keep a record of time spent on the tasks within the assignment.

Task

1. At the first meeting of the research and development team, examine the report on the market research in order to help establish the voltage and current requirements for the power supply.
2. Specify the voltage and current requirements and explain how the results of the market research led to the choice of specifications and what reference to other data sources was made.
3. Design the electrical circuit:
   - Make brief notes on the action of the transformer and its purpose in the module. Refer to catalogues and, bearing in mind the specifications, size and cost, choose a suitable transformer. Justify your choice, giving its catalogue number and cost.
   - Make brief notes on the action and purpose of the rectifier. Decide on full- or half-wave rectification and justify the decision. Describe rectifying circuits and choose a suitable one. Refer to catalogues and choose components for the circuit. Justify the choice, giving catalogue numbers and cost.

— Make brief notes on the action and purpose of the smoothing unit and explain the term 'output ripple'. Use textbooks to find different methods of smoothing. Investigate practically the different methods and choose a suitable one (output ripple should not exceed five per cent). Write an account of the investigations.

— Refer to catalogues and choose components for the smoothing unit. Justify the choice, giving catalogue numbers and cost.

— Make brief notes on the action and purpose of simple stabilising circuits and explain the term percentage regulation. Use textbooks to find different methods of stabilisation. Determine whether stabilisation is needed in this power supply and, if so, choose a suitable method and refer to catalogues and choose components for the circuit. Justify the choice, giving catalogue numbers and cost.

4. Build and test the prototype electrical system:

— Construct the power supply circuit and ensure that it meets the required specifications.

— Write an account of your testing procedures, indicating any problems encountered and methods of solution.

— Use the system with a personal stereo and ensure that it performs adequately for all functions of the equipment. Make adjustments if necessary.

5. Prepare for the second meeting of the research and development team:

— Have the prototype power supply ready for demonstration to the team.

— Prepare a paper with the following information: circuit diagram, list of components required and their cost, total cost of the circuit, your suggestion as to how the circuit may be mounted and the costs involved for quantity production.

6. Colleagues from the Business Studies section should be invited to the research and development team meeting, since they will have to be involved in the costing. A paper should be presented to the meeting and the agenda for the meeting should include:

— demonstration of circuits available;

— consideration of costs of each circuit;

— final choice of circuit design for use in the manufactured power supply;

— choice of board and method of mounting the circuit.

A brief account of the meeting should be written. It should state the decisions made and explain the reasoning behind those decisions.

7. Design the containing box for the materials and choose the materials from which it is to be made:

— visit retail outlets to collect information on design possibilities for the box, including methods of connection to the mains supply.

Other considerations may be the positioning of a protective fuse and the ease with which circuit repairs can be carried out;

— design the containing box and include its dimensions. Give reasons for the design choice;

— consider the physical properties of the box material. Choose suitable materials and obtain samples for testing. Devise and carry out tests on these samples and write an account of them. Choose the material for the box on the basis of the tests.

8. Prepare for the third meeting of the research and development team. Prepare a paper which illustrates and justifies the choice of box design and material. Include the costs involved.

9. Again invite colleagues from the Business Studies section. Present your paper to the meeting, where the main agenda item is the choice of box design and material. Write a brief account of the meeting, stating the decisions made and the reasoning behind those decisions.

10. Prepare a file on the research and development programme, to include:

— a record of how the assignment was carried out;

— reports on the research and development team meetings;

— the circuit design chosen for production and its full specification, including a forecast of costs;

— the box design chosen for production and its full specification, including a forecast of costs;

— the cost of the research and development programme.

Stage 5. Sales launch

Task

The time has now come to promote and sell the power supply units for the personal stereo systems.

1. Hold a general meeting to discuss:

— the date, time and venue of the sales launch;

— the costs for catering, presentation of product, package of publicity material, room hire and specialist equipment.

2. Write a letter to the catering students requesting information for a buffet and arrange a meeting to discuss costs, room hire, appropriate menus. After the meeting call a general meeting of the board and select the most appropriate arrangements. Write to the catering students formally specifying the arrangements.

3. Choose a suitable room for the oral presentation and prepare a talk with accompanying video and audio visual material to last at least 20 minutes. Tailor the talk to the client group. Try to anticipate questions that will be asked and have answers prepared. At the presentation be prepared to take orders for the product and devise an appropriate order form.

4. Create a database of likely clients. Design and produce a mail shot to be sent to the potential audience. Write a standard letter to be sent with the publicity package and another inviting the press to attend. Design a standard invitation letter with a reply slip.

5. Design a package of publicity material which will be included with the mail shot. Use desk top publishing facilities to prepare a booklet explaining the product. Prepare a price list, details of any discounts and a statement detailing after-sales service.

Assessment

Assessment is largely based on the presentations made by the students at the end of an assignment.

NB. The assignment has been used to develop common, core and subject area skills for all the BTEC courses within the college. It is a college-wide assignment which is planned to be ongoing for future years.

In the first year of the project all students met as one group and arranged themselves in groups of four, one per department, to start the first assignment (to produce the market research form). Once this had been done the groups pooled their ideas under the control of three joint chairpersons. The process then rolled on from there.

In future it is intended that a common period will be set aside to facilitate student interaction.

12. Fast-food container

College:	Swindon College
Target group:	BTEC HND Packaging Design, HNC and C&G Engineering and Catering courses.
Estimated time:	One year

Scenario

A client, the Hotel and Catering Department, has a need for fast-food containers. The container needs to be designed to a brief arrived at with the client and with special reference to manufacture, dispensing and after-sales use of pre-portioned units, and easy modification to increase viable use. The problem of the packing material to be used requires consideration in the light of the phasing out of CFCs.

Task

1. Meet the client and discuss the details of the brief, including:
   - the initial research required to arrive at a specification;
   - defining the problem;
   - product modification;
   - product costing;
   - usage;
   - diet/hygiene/shelf-life considerations;
   - size of order.
2. Develop a provisional specification.
3. Meet the client to discuss the proposed specification.
4. Design the container. This will involve initial designs and prototypes, modifications and then full working drawings. The material to be used will also require consideration.
5. Manufacture the mould.
6. Manufacture and test the product.
7. Make a presentation to the client.
8. Consider the wider implications of mass production and marketing.

Assessment

Marks out of ten were awarded for each of the following areas and an average obtained:

- research;
- use of materials/techniques;
- understanding and interpretation of the problem/brief;
- originality and creativity;
- finish/execution and presentation;
- suitability of design (cost/materials);
- completion of work to deadline.

13. Your company and the employee with a disability

College: Swindon College
Target group: BTEC National Certificate in Computer Studies
Estimated time: Varies

Scenario

For some years legislation has existed to encourage larger firms to employ people with disabilities. This does not appear to have been monitored effectively. Many companies plead that their exceptional circumstances do not permit them to fulfil their legal requirements. However, the advent of new technology and equipment should allow greater numbers of people with disabilities to take on normal jobs. This will not only enhance the quality of life of people with disabilities but could increase the size of the skilled labour pool.

Task

1. Find out what the existing legal requirements are with respect to the employing of people with disabilities by companies.
2. Find out the existing policy of your company.
3. Gather appropriate statistical data on the employment of people with disabilities in your company, categorising the various disabilities as you feel most appropriate.
4. Compile a report on the above three tasks in a form suitable to be presented to the head of your company's personnel department. In addition a group report is to be produced suitable for presentation to the Borough Access Officer.
5. Identify practical means of helping people with disabilities to work, with particular reference to high-technology equipment. Present a report on this to the group.
6. For a specific person with special needs in a given job, design and cost a suitable working environment. Present a report on this to the group.

Assessment

The assessment was against a list of competences with employers involved as assessors. The competences are as follows (for each competence, performance criteria are given):

- Research the legal requirements in the library. (Accurately reproduce the law in concise, simple form.)
- Investigate the company policy through interview, telephone calls, and inspection of documents. (The policy is to be written clearly and the sources of information clearly specified.)

- Sort the various kinds and degrees of support and adaptations that people need. (The list should be a practical categorisation.)
- Gather data on the numbers in each of the categories. (The data should be appropriate and adequate for the task.)
- Present data which has been gathered. (The data is to be clearly laid out in tables and graphs, appropriately labelled.)
- Write a report in a properly structured manner for presentation to the head of the personnel department. (The report should contain an introduction explaining the context and purpose of the report, the evidence and the conclusions to be drawn. It should use grammar, language, vocabulary and sentence structure suitable for internal company use.)
- Contribute to group discussion effectively. (Each member should make a useful contribution.)
- Prepare a group report effectively. (The result must be a coherent report.)
- Research the aids available. (The list to include aids for all categories of special needs previously identified.)
- Present the aids data gathered. (The presentation should be effective and make good use of available equipment.)
- For a particular person with disabilities, describe the support and adaptation required. (The description must be comprehensive enough to enable the reader to understand the extent of the support required.)
- Describe the job to be tackled by the person with a disability. (The mental and physical tasks required by the job should be clear.)
- Design and draw a layout for the job to be tackled by the person with a disability. (The design should be practicable and drawings should be clear.)
- Calculate the costs of the design. (The costs of all component parts should be identified, being broken down into capital and running costs.)

14. Introduction of CAD

College:	Richmond College
Target group:	BTEC HNC Engineering
Estimated time:	Varies

Scenario

At the instigation of the production director of Hitec, the board has agreed to set up a team of three to four engineers, recruited from outside Hitec, to investigate the feasibility of introducing a CAD system into the company. The team will act in an advisory role and will be nominally responsible to the production director although it will make its recommendations to the board.

The students are to be that team and must produce a report suggesting an implementation strategy and justification for a CAD system. To assist, an economic model of the design office has been produced on a computer spreadsheet. Use this to explore strategies that might be used to establish a cost justification for introducing the system. This might involve alterations to the present management structure and work patterns of the company.

Task

The presentation to the board will:

1. suggest a suitable system for the company;
2. produce an analysis of the hardware and software costs;
3. produce a timetable for implementation;
4. examine the training and industrial relations implications of introducing the new equipment;
5. estimate the likely productivity of the system and the time needed to set up a working database;
6. produce a reasoned justification for introducing the system.

It is suggested that individual members of the team take on specific tasks associated with the above work and individual responsibility for the presentation of that material to the board.

NB. A substantial paper giving company details was given to the students. The following are the main aspects of that paper.

Hitec Engineering plc

Hitec Engineering plc is a Midlands company making and selling high-specification machine tools and production systems to the engineering industry, mostly in the automotive and aerospace sectors.

The company was founded in 1924 to make precision parts for the developing motor industry. It has since expanded and now employs 240 people. As Hitec's products shifted towards machine tools, its markets expanded until 50% of its sales are to the UK industry, 40% to EEC countries and 10% to the USA. This has pertained for five years.

In terms of the sales turnover and profit after tax, the company has recently found life difficult. The figures below are adjusted to take account of inflation and relate to present day price levels.

	1982	1983	1984	1985	1986
Sales turnover (£m)	13.5	13.5	13.2	13.1	12.7
Profit after tax (£m)	1.5	1.4	1.0	0.9	0.7

In 1982, 70% of the company's sales were of standard precision machine tools (boring machines, grinders and milling machines) and the remaining 30% were special customer-modified machines with transfer line systems. Since then, increasing emphasis has been placed by customers on customised machine tools linked to transfer lines with automatic load and unload facilities, so that by 1985 60% of the sales were of this kind.

During 1985, 12% of tenders made were accepted. This showed a continuation of a downward trend; in 1980 the figure had been 18%. In 1985 the value of orders ranged from £50,000 to £1.2 million, the average value being £250,000 and the median order value £100,000.

Overall, the company now employs 240 people. A substantial reduction has been made over recent years, largely due to the introduction of computers into the manufacturing operations. These are now based around three CNC machining centres, two NC planomiller machines with each having a double work table and two sideways grinders. A one- shift system is currently worked and at this level of operation the plant is run at 80% capacity.

Company management

Members of the founding family have always been influential in the running of the company, holding all the major executive director posts up until 1977, and the company reputation for engineering skill and quality has always been uppermost in the minds of the directors. In 1977 a production director from outside the family was appointed. It was he who introduced the machine tools. In 1982 an 'outsider' was appointed technical director with responsibility for design and development operations. Although an outsider in the sense of not being a member of the founding family, this technical director was promoted from within Hitec, having joined as a graduate apprentice in 1956. The managing director is a member of the family.

The company is tightly organised in a hierarchical structure, with everyone's job well defined, and no-one is left in any doubt about what decision he/she can take and what must pass upwards. In practice, relatively little discretion is left to subordinates as the general attitude of directors and senior management is one of benevolent authority. This is reflected in moderate salaries and a company policy of no redundancies. (The installation of the computer- controlled production plant and the consequent drop in the number of staff was achieved through natural turnover and retirement.)

Industrial relations

There is a small personnel administration department at Hitec. The company has never known a strike, but it does recognise AUEW for collective bargaining for production workers and TASS-AUEW for design and other office workers. Seventy per cent of the shop floor workers and 60% of the

white collar workers belong to the appropriate trade union. There are no formal procedure agreements, the company having found them unnecessary, and communication of the company plans is largely by word of mouth from the top downwards.

The company subsidises a sports and social club and generally prides itself on looking after the welfare of its employees.

The design office at Hitec

The design office at Hitec performs three major functions and is organised into corresponding sections.

The 'Proposals Section' prepares machine drawings and specifications for incorporation into tender documents. Four 'amplification engineers' are responsible for technical communications with prospective and present customers; they draw up technical specifications for tenders, supervise installation and commissioning work as necessary, and liaise closely with four marketing engineers (not members of the design office) who handle commercial aspects of tender work, including costing and pricing, based on the technical specification produced by the applications engineers. Most of the work in the proposals sections is concerned with selecting from standard sub-assemblies (making modifications as necessary) to create machines to customer specifications. The amplification engineers delegate much of this work in detail to six design draughtspeople.

The 'Mechanical Design Section' prepares detailed assembly and sub-assembly drawings of standard machines, fixtures, tooling and transfer systems. Eight design engineers and ten design draughtspeople are employed. Of the total work carried out by the section, 40% of the detail design drawings are carried out by sub-contracted firms working for Hitec.

The third section is the 'Control Section', which designs pneumatic, hydraulic and electrical systems and prepares appropriate schematic diagrams of hydraulic piping, pneumatic piping and electrical wiring. Five design engineers and seven design draughtspeople are employed. Again a substantial amount of detail design is carried out by sub- contracted designers; roughly 50% of all drawings are prepared outside Hitec.

Design office organisation

The staffing structure of Hitec's Design Office, therefore, is as below, the Design Office Manager reporting to the Technical Director.

Details of all the design office personnel (salary, years in service, age and married/single/divorced status) were also supplied.

15. Mains plug casing

College: East Warwickshire College of Further Education
Target group: BTEC Certificate in Engineering (block release)
Estimated time: Six weeks at four hours per week

Scenario

The students are employed by a company whose products include three-pin electric plugs. The company manufactures the outer casing for the plug and buys in the other components.

The product development manager of the company has just been presented with a market survey on the three-pin mains plugs. One of the conclusions from the survey is that many people, particularly the old, have difficulties inserting and withdrawing plugs from their sockets. The product development manager thus decides to set up a team to produce a design for the outer casing of a three-pin mains plug to enable a person with limited use of hands and minimal strength in their arms to insert and withdraw the plug easily and with complete safety.

The students are to act as that team.

Task

1. Produce a schedule for the tasks given below, allocating times for each task and the person(s) to do them.
2. Contact and interview a person who has a disability which means that they have difficulties in handling three-pin plugs.
3. Research and analyse the other normal three-pin plugs on the market, the price, the casing material, designs for holding the cable and fuses, etc.
4. Find out about the properties of the various materials used for the outer casing, e.g. strength, flammability, cost and the manufacturing processes that are used to form the casing.
5. Produce possible designs for an outer casing so that a person with very little grip and little strength in their arms can use the plug. The plug must conform to the appropriate BS specifications.
6. Evaluate the designs, considering safety, durability, ergonomics, properties of the outer casing material and how easy it would be to modify the manufacturing process, spatial and aesthetic aspects and costs.
7. Select the most appropriate material and manufacturing process for the outer casing. Explain how the process will have to be modified as a result of your design, e.g. change of mould and tooling.
8. Establish the cost of producing the design and what effect the modifications have had compared with the cost of a conventional plug made from the same material.

9. Present a final written and verbal report to the product development manager of the company.

Assessment

Grades were given, as a result of peer-group assessment, self- assessment and lecturer assessment, in the following:

Product	Grade
Communication - written	
Communication - oral	
Practical skills	
	Overall:

Process	Grade
Self-management and organisation	
Working with others	
Problem-solving and design skills	
	Overall:

As an illustration of how grades were allocated, for problem-solving and design skills the criteria used were:

- Distinction: the student has shown a full consideration and understanding of the needs of the person with disabilities in this context and has:
  - evaluated a suitable material and given detailed reasons for the choice, including costs and ease of manufacture;
  - evaluated the possible methods of production and the modifications required, including costs, and presented arguments for and against the various issues involved;
  - produced several designs and assessed which is the best to use.
- Merit: the student has shown an understanding of the needs of a person with disabilities in this context and has:
  - indicated knowledge of the materials available and made a reasoned choice;
  - presented a reasoned argument for the choice and necessary modifications of the methods of production, calculating the possible costs involved;

— produced at least two designs and assessed which is the best to use.

- Pass: the student has shown some understanding of the needs of the person with disabilities and has:
  - — found out the properties of some of the materials that could be used for the outer casing;
  - — researched possible production methods and suggested one method, together with possible modifications;
  - — produced a design that will work.
- Referral: the student has shown little understanding of the needs of the person with disabilities and has:
  - — mentioned only a few properties of one or two available materials;
  - — carried out very little research into possible production methods;
  - — produced a design of doubtful use.
- Fail: the student has shown no understanding of the needs of those with disabilities and has:
  - — not mentioned the properties or identified available materials;
  - — carried out little or no research into production methods;
  - — produced no specific design.

NB. The students work in groups of three, with each group member taking it in turn to be the project leader/director.

16. Materials and processes selection

College: East Warwickshire College of Further Education
Target group: BTEC National Certificate in Engineering
Estimated time: 12 hours

Scenario

The selection of the materials and processes for the manufacture of bolts or gears or some other engineering component involves many variables and thus can, be complex and time consuming. The creation of a computerised database can, however, make the selection simple and quick. The ADEX ADVISOR expert system shell can be used to create such a selection system.

Task

1. Learn how to use ADEX. A number of sample knowledge bases are provided with the package and should be used to learn the skills of interrogating, editing and creating a knowledge base.
2. Collect information on materials and processes for the manufacture of some engineering component.
3. Using this data, create a knowledge base for materials and process selection for the manufacture of the component. Test it and refine as necessary to ensure correct advice is given.

Assessment

Grades were awarded using a similar method and criteria to that shown in assignment 15.

NB. ADEX is part of a package available from FEU. The assignment could be adapted to work with most commercially available expert system shells.

17. Water pump

College: East Warwickshire College
Target group: BTEC First Certificate in Engineering
Estimated time: 20 hours

Scenario

The members of a local narrow boat club have asked the college to design a lightweight bilge pump. The pump should be constructed from materials and parts which can be purchased at any hardware shop. A range of suitable materials and parts will be made available to you.

Task

The aim is to design and build a water pump, powered by a standard twelve-volt motor unit, which can deliver one half litre of water over a height of one metre in the shortest possible time.

1. Using the information obtained from a computer simulation and/or a library search, produce a working design in the form of sketches and/or models of the pump components to satisfy the above aim.
2. Select suitable materials for the construction of the pump body, piston, valves, etc., and keep a record in a logbook of any alternative materials, designs, and problems encountered.
3. Produce a print-out of the pump assembly drawings using simple CAD software.
4. Assemble the pump.
5. Test the pump performance and make any modifications required. Keep a record in a logbook.

Assessment

From observation and inspection of drawings, print-outs and the pump produced, grades were determined for each of the following:

Product assessment	
Product	*Evaluation criteria*
Water pump design	Accuracy of sketches, design of valves, CAD assembly drawing and presentation
Water pump	Standard of manufacture and performance
Process assessment	
Skill	*Assessment/observation*
Self-development (learning, studying, managing, organising)	Observation sheet, logbook, organisation of tasks

Skill	*Assessment/observation*
Working with others	Observation sheet, completing a group task, assisting effectively
Communication	Sketches, logbook, oral effectiveness
Practical skills	Manufacturing method and implementation
Design skills	Fitness of design for purpose
Use of IT	Successful production of drawings using CAD

NB. A staff data sheet is provided. This indicates the work plan and resources required, involving, in this case, the use of the lift pump simulation software to demonstrate the method of operation of a lift pump, assessment criteria and an assessment record sheet.

18. Computerised inspection

College: Bath College of Further Education
Target group: BTEC HNC in Mechanical and Production Engineering
Estimated time: Varies

Scenario

The Pitts Manufacturing Company has a major quality problem. Consultants propose the installation of a series of computerised inspection stations on the shop floor to provide a system of data capture and analysis. However, the managing director decides to implement a pilot study covering the inspection of a specific range of turned components.

The following specification was issued by the project engineer:

- Number of diameters per component: Min = 2, Max = 4
- Min. diameter = 4 mm, max. diameter = 25 mm
- Lengths of diameters: Min. 3 mm, max. 15 mm
- No. of inspection stations: 3
- Production rate: 360 components/hour/station
- Data required:
  - — Reject rate (%)
  - — Statistical analysis of quality
  - — Status of current component batch
  - — Useful management information (unspecified)
- Completion up to test stage: 24 weeks

Task

1. Analyse the above information and produce a detailed programme of work for each specialist group, together with a detailed technical specification from which they will work. Additional information is available, but only when the appropriate questions are asked!
2. Put forward proposals. Try to evaluate as many alternatives as possible. Catalogues and references on transducers and instrumentation are available if required.
3. Make a presentation of your results. Where appropriate, sketches should be used to show general arrangements of assemblies, block diagrams of systems, etc. An overhead projector is available. A bar chart should be produced to show the planned phases of the project within the 24-week delivery requirement.

Assessment

Assessment is against a list of common skill areas.

19. Air pollution

College: Waltham Forest College
Target group: BTEC First Diploma in Science
Estimated time: One week full-time

Scenario

Pollution, and in particular air pollution, is becoming an issue of major concern to many local pressure groups and individuals. The claims are apparently often based on little firm evidence, thus there is a need for a well-researched, data-supported report on air pollution in the area.

The student group has been commissioned to produce this report.

Task

1. Identify what is meant by 'air pollution'. Use the library and departmental sources to establish which substances in the atmosphere comprise pollutants, where they originate from and the effects they have on the environment.
2. Obtain data on local air pollution. Data on methods used and typical results can be obtained by visiting the local Environmental Health Office.
3. Using departmental resources, design and carry out a survey to look at lichen distribution in a specific area. Analyse the results and explain their significance in relation to air pollution.
4. Obtain information on air pollution as a result of exhaust emissions from vehicles. Consider the effect of lead in petrol, why it has been added, the effects of lead on the environment and human beings, and the methods such as catalytic converters and unleaded petrol used to reduce such effects. Carry out an analysis of public awareness in this locality in relation to leaded and unleaded petrol and its significance for the environment and human beings.
5. Write and present a report on air pollution in this area.

Assessment

Assessment is against a list of common skills, grouped under the headings of:

- self-development
- learning and studying
- self- management and organisation
- working with others
- communicating
- skills associated with science and technology
- information-seeking and analysis
- using information technology
- identifying and tackling problems
- numeracy
- practical skills
- design skills

NB. The above assignment was one of a cluster grouped under the overall title of pollution. Assignment 20 was also one of the cluster.

20. Noise pollution

College:	Waltham Forest College
Target group:	BTEC First Diploma in Science
Estimated time:	One week full-time

Scenario

Noise pollution is becoming an issue of major concern to many local pressure groups and individuals. The claims are apparently often based on little firm evidence and there is a need for a well-researched, data-supported report on noise pollution in the area.

The student group has been commissioned to produce this report.

Task

1. Research the topic of noise pollution, identifying the nature of noise, its measurement using the decibel scale and possible harmful effects.
2. Design a survey of noise levels in the locality, considering how the measurements are to be made, the recording of the data and where the measurements are to be made.
3. Carry out the survey, considering both quiet and noisy areas and the possibility of changes in noise levels at different times of the day.
4. Investigate the way the Council deals with noise problems by visiting the local Environmental Health Office. Some thought must be given, prior to the visit, concerning the kinds of questions on noise to be asked.
5. Write and present a report on noise pollution in the area. In particular address, with the aid of results obtained from the survey and information from a variety of sources, the issue of the possible harmful effects of noise.

Assessment

As in assignment number 19.

21. Tap water

College: Waltham Forest College
Target group: BTEC National Diploma in Science
Estimated time: See note

Scenario

According to the press there is concern about the quality of the water 'on tap' in our homes.

The student group has been commissioned to investigate the extent of such a concern in this area and whether it is justified.

Task

1. Ascertain consumer attitudes to tap water as an acceptable and safe beverage. This will require decisions on the criteria to be used to determine 'acceptability'. Design a questionnaire, consider how and who to survey, carry it out, analyse the results and consider what conclusions can be drawn from it.
2. Determine the quantity of water used on average by families in one day and the purpose for which the water is used. This might be incorporated as part of the survey in (1). How is the quantity affected by changes in the quantity of, and technological advancements in, domestic appliances?
3. Investigate temporary and permanent hardness in tap water and comment on the significance of the results.
4. Determine the microbiological contamination of tap water and assess the effect of heat treatment and chlorination.
5. Write and present a report on the water 'on tap' in the area, drawing on the data obtained in the above tasks and any other relevant data that can be located.

Assessment

As for assignment 19.

NB. This is a grouping together of a number of tasks in a Waltham Forest College collection of assignments on water.

22. A car jack

College: Chichester College of Technology
Target group: BTEC Engineering Certificate/Diploma, CGLI 201.
Estimated time: 30 hours

Scenario

Car Accessories Ltd. is a small company that makes car accessories for sale through DIY car component shops and large store outlets. The managing director, after having to replace a car wheel following a puncture, feels there may be a market for an improved car jack.

The student team has been commissioned to propose possible designs.

Tasks

1. Design a questionnaire that can be used to survey car owners and establish their requirements for car jacks and the points with regard to existing forms of car jack that they find annoying.
2. Carry out the survey and analyse the findings.
3. Produce a specification for a new car jack.
4. Produce possible designs for car jacks, taking account of ergonomic considerations and safety.
5. Consider the materials that could be used, the manufacturing processes and costs.
6. Evaluate the designs and decide on the optimum design.
7. Write a report for presentation to the managing director, including recommendations for possible action. In the report outline the advantages and disadvantages (including cost) of the new design compared with existing car jacks. It should also include general assembly drawing and detail drawings, together with any calculations.

NB. The assignment is based on one developed at Chichester College.

23. A baker's problem

College:	Calderdale College
Target group:	Introductory course
Estimated time:	See note

Scenario

A small bakery wishes to expand in a very competitive market. It already sells bread in various forms and has recently increased its product range to include scones and cream cakes. The company has been in existence for only 22 months and has been trading successfully during that period, establishing a distribution chain of one supermarket and 19 smaller outlets. Assuming nothing changes to the detriment of the company, the forecast for the future is that a continued growth in demand will take place.

To meet any increased demand, the company would need one more baker immediately and would need to plan to employ another in six months time, taking the workforce up to 12 personnel. All company records have been kept in traditional hardback ledger format by the owner of the company, who also acts as the overall supervisor.

Task

The owner is thinking of buying a computer to help with the paperwork and organisation associated with the increased demand and expansion of the company but knows nothing about computers and has thus come to the college to ask for help. Your team has been given the task of determining what is required.

1. Some of the duties the owner will carry out in an average week are:

   — ordering materials
   — keeping a check on stocks of the materials in store
   — keeping track of bills received and paid
   — paying and keeping records of wages paid to employees
   — maintaining a record of trading for VAT purposes
   — planning production to meet orders

   List all jobs that you consider the owner will need to do.

2. Which jobs could be beneficially tackled by computer?

3. What hardware and software would be required?

4. What training and other support would the owner need?

5. Prepare a report for the owner with your recommendations.

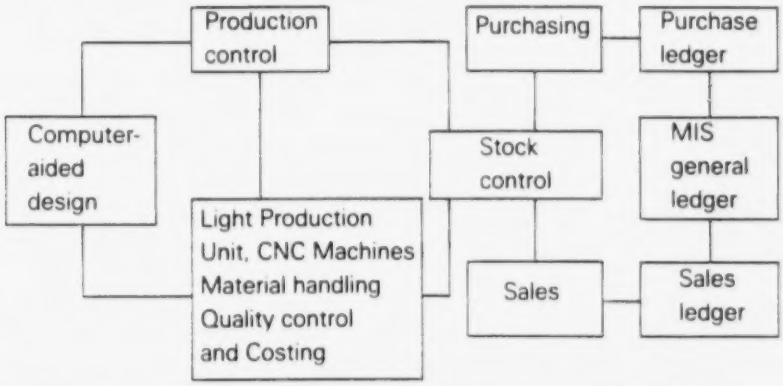
Assessment

The emphasis in this project is to lead students towards self-assessment. Using prepared question and answer routines, students identify areas of work where they require more assistance. Small peer-group discussion sessions, and consultancy by appropriate lecturers assist in solving learning problems.

NB. The college has established a unit for integrated manufacturing technology using IT. An open workshop has been created for use by students from different vocational areas. The aim is that engineering students will have the opportunity to gain experience in administration, planning and accounting systems, and that business students will be given an insight into design, costing and production processes.

The facility includes reception, marketing, sales, accounts, CAD, planning, stock control, production control, quality control and Flexible Manufacturing System (FMS). Output from each zone is used by interacting zones to control production of a range of products.

Figure 1 shows a diagrammatic layout of the unit.



A range of learning packages have been developed to guide students through the different aspects. The above assignment is a brief, edited extract from an introductory package.

Appendix A. Participating colleges

1. Bath College of Further Education
2. Calderdale College
3. Chichester College of Technology
4. Crosskeys College
5. East Warwickshire College of Further Education
6. Halesowen College
7. Kingston College of Further Education
8. Matthew Boulton College
9. Mid-Kent College of Higher and Further Education
10. Richmond College
11. Swindon College
12. Waltham Forest College

Appendix B. Project Steering Committee

1. Mike Ridley, NCVQ
2. David Esther, Training Agency (until Mar 1989)
3. Malcolm Cribb, Training Agency (from Apr 1989)
4. J.Lewis, Kingston College of Further Education
5. B.Hellingsworth, Kingston College of Further Education
6. Noel Meeke, GlosCAT
7. Keith Roe, GlosCAT
8. John Williams, Engineering Council
9. Albert Clyde, FEU
10. Bill Bolton, FEU Consultant

The visits to the colleges were organised by Noel Meeke and undertaken by Gerry Kent, Keith Roe, Ian Stokes and Malcolm Thomas (all of GlosCAT).